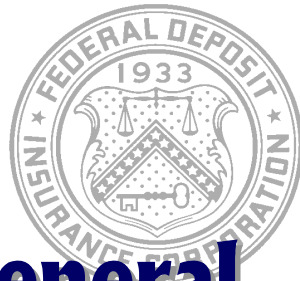


# Office of Inspector General



September 25, 2000  
Audit Report No. 00-043


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Audit of DIRM's Actions to Ensure  
Quality Products



**DATE:** September 25, 2000

**TO:** Donald C. Demitros, Director,  
Division of Information Resources Management and Chief Information Officer

**FROM:**   
David H. Loewenstein  
Assistant Inspector General

**SUBJECT:** *Audit of DIRM's Actions to Ensure Quality Products*  
(Audit Report No.00-043)

The Federal Deposit Insurance Corporation (FDIC) Office of Inspector General has completed an audit of the FDIC's activities to ensure quality information systems. The overall objective of this audit was to determine the effectiveness of the Division of Information Resources Management's (DIRM) quality assurance (QA) activities related to the development and implementation of information and financial systems. While prior audits addressing systems development efforts have generally been comprehensive reviews related to the management of a specific project, this audit focused on overall DIRM activities to ensure quality deliverables and identified several opportunities for improvement.

## **BACKGROUND**

The purpose of quality assurance (QA) in the systems development arena is to ensure the delivery of quality systems that meet users' needs in a timely and cost-effective manner. Prior to 1998, a small group within DIRM's Management Review Section administered a QA program. This group has since been abolished and the associated DIRM circular on QA rescinded. According to DIRM officials, these actions were based on a decision to eliminate a centralized QA function and increase the responsibility and accountability of DIRM Project Managers and line managers for delivering quality systems.

The need for effective QA has been illustrated by prior systems development projects that were often delayed or not fully successful. DIRM's reliance on contractor support for systems development efforts and today's more complex information technology (IT) infrastructures increase the challenges associated with developing effective systems that meet user needs and are delivered in a timely manner. During 2000, DIRM plans to spend as much as 59 percent of its personnel-related expenditures for outside contractors. The use of contractor personnel can impact quality because of: (1) the lessening of FDIC's control over the process, (2) increased risk of personnel turnover during the project, and (3) the fact that contractor personnel are less familiar with the FDIC's practices and business activities. Further, today's systems development activities are taking

place in an environment of increasingly more complex and rapidly changing technology. The IT infrastructures used in today's distributed systems require that systems developers successfully interface a variety of computer environments and software technologies.

A strong QA program supports project managers and line managers in ensuring effective coordination among the various DIRM organizational components needed to support today's development projects.

QA related to information systems development includes two key components: (1) verification that work products are complete and comply with systems development policies and procedures and (2) validation by the client that the work products reflect their needs. A QA program consisting of these components addresses the quality of the planned system and the development process being used to create it. Verification determines the degree of clarity, traceability, internal consistency, and completeness for each of the products developed during the life cycle phases. An important aspect of verification is determining the degree of compliance with system development life cycle (SDLC) documentation standards. FDIC's standards are published in the *FDIC SDLC Manual*, a comprehensive set of instructions that describe required processes and documentation for each of the development phases. Validation determines whether each of the products captures the client's expectations. Although the most common form of validation is system testing near project completion, effective validation addresses the completeness and accuracy of work products throughout the development process. Validation is typically performed by client personnel, i.e., representatives of those who will be using the system. However, it may also be performed independently, often by contractors. Independent validation would normally be performed only in particularly large-scale, critical projects.

## **OBJECTIVE, SCOPE, AND METHODOLOGY**

The objective of this audit was to determine the effectiveness of DIRM's QA practices regarding systems development projects. We did not attempt to determine the overall degree of success of individual projects. Accordingly, the scope of this audit did not include project planning and administration, but instead focused only on the quality assurance activities related to the developed work products. The work products addressed in this audit were those produced in four of the eight phases of the SDLC. These are the requirements definition, external design, internal design, and test phases. These associated work products are developed during these phases as described below.

- **Requirements Definition Phase** - In this phase, user needs are analyzed and user requirements are formally defined. These requirements include system functionality, data requirements, system performance, security, and maintainability.
- **External Design Phase** - In this phase, the external physical characteristics of the application system are designed, including the operating environment, user controls such as menus and graphical interfaces, and system outputs such as screens and reports.
- **Internal Design Phase** - In this phase, a detailed structure of the system is designed, the system is partitioned into one or more modules, and detailed logic specifications are prepared for each

module. An initial Conversion Plan is developed that documents the strategy for converting from an existing system to the new system.

- **Test Phase** - In this phase, DIRM and system clients perform tests. DIRM performs tests of the individual system components, followed by DIRM and the client together testing the system as a whole.

To accomplish the audit objective, we reviewed seven ongoing or recently completed projects and three completed projects that we had previously audited. Regarding the latter, we limited our review to the audit reports and related working papers. For the ongoing or recently completed projects, we reviewed documentation and interviewed key project personnel. In evaluating the thoroughness of test phase activities, we selected samples of detailed systems' requirements and traced them to associated test scenarios. The three completed systems selected for our review were the General Examination System (GENESYS 1.0), Time and Attendance Processing System (TAPS), and Electronic Travel Voucher Processing System (ETVPS). We selected the other seven projects for review based on suggestions from DIRM officials, the need to cover a diversity of client organizations, and the need to ensure adequate audit coverage for each of the development phases. The current or recent projects reviewed were the (1) Assessments Information Management System (AIMS II), (2) Electronic Procurement Request and Invoicing System (EPRIS), (3) General Examination System (GENESYS 2.0), (4) National Asset Information System (NAIS), (5) Statistical CAMELS Offsite Rating System (SCOR), (6) Structure Information Management System (SIMS), and (7) System of Uniform Reporting of Compliance and CRA Exams (SOURCE). We do not refer specifically to these projects by name in the text of this report; however, we shared our observations on each project with the respective Project Managers.

This audit included system development activities occurring over approximately 3 years beginning in 1997. We conducted the audit between February and May 2000 in accordance with generally accepted government auditing standards.

## **RESULTS OF AUDIT**

Effective QA for system development projects helps to ensure consistent quality and timeliness of project deliverables. Without an effective, comprehensive QA process, project success is overly dependent on the knowledge, experience, and capabilities of the DIRM Project Manager. We identified opportunities for DIRM to improve overall QA effectiveness by formalizing certain processes related to verification of contractor work products and ensuring compliance with SDLC requirements. These opportunities are based, in part, on best practices of DIRM Project Managers that were identified during the audit.

Our review of DIRM's verification of contractors' work products noted inconsistencies in the extent of review performed by the responsible Project Managers. As a result, the accuracy and completeness of the work products varied. However, we noted one ongoing project for which the

Project Manager placed particular emphasis on reviews of contractor-provided work products. We believe that this focus contributed to the high quality of deliverables for this project and the rapid progress toward project completion.

The emphasis given to verification can affect the degree of compliance with the FDIC's SDLC documentation standards. We noted that the degree of compliance varied by individual SDLC phases and those project phases with the better levels of compliance were the Requirements Definition and Test Phases. Substantial improvement is needed for compliance in the External and Internal Design phases. The needed improvements include a more adequate description of the proposed technical architecture and enhanced guidance regarding when and how the External Design Document and the Internal Design Document can be combined. We also noted a number of other departures from the SDLC standards relating to missing documentation, links between the Test Plan and the Functional Requirements Document, and missing elements in the Internal Design Document.

In prior audits of two of the earlier development projects, we had noted insufficient validation of requirements by the project team. However, for all current projects reviewed, the project teams were consistently validating users' requirements. This change was due, in part, to the teams more consistently following a practice of developing requirements on an incremental basis and iteratively reviewing portions with client personnel. In addition to such validation efforts performed by the project team and client personnel, specific situations can dictate the need for independent validation. Sometimes it is prudent to use an independent validation process where the development effort will support a large or varied user population. Another indicator of the need for independent validation is whether there has been a long duration required for the development effort during which time there has been a significant turnover of client representatives and/or major changes to the client's business practices. For the current projects reviewed, we did not identify any projects meeting such criteria and thereby pointing to the need for independent validation.

## **CONSISTENT VERIFICATION OF CONTRACTORS' WORK PRODUCTS NEEDED**

DIRM Project Managers and staff were not consistent in the level of verification they applied to contractor work products. Verification is the review process to ensure that development work products are clear, traceable to other documents, consistent, and complete. For one project, the DIRM project team did not effectively communicate with contractor staff to ensure that user requirements were completely defined and all design issues were resolved. For another project, the DIRM project team did not verify the contractor's work products before forwarding them to the client. Instead, the contractor followed a practice of releasing portions of deliverables simultaneously to the DIRM project team and the client. The contractor also communicated independently with the client staff. In order for the DIRM Project Manager to exercise full responsibility for ensuring thorough verification of contractor work products, this individual should be involved in all communications between contractor development personnel and the client.

Because DIRM extensively uses contractor-supplied resources for systems design and development work, the need for work product verification by DIRM project personnel is increased. The FDIC Acquisition Policy Manual directs that DIRM, as the organization responsible for project management, should review all work products received from contractors. Such review is best performed before forwarding deliverables or portions thereof to the client organization for additional review, because DIRM's focus is on verifying overall completeness and quality while the client's focus is on validating whether the proposed system will meet its needs. Also, DIRM participation in all communications between the client and the contractors will increase DIRM's ability to effectively verify resulting documentation.

We found that DIRM verification contributed to the overall progress of projects toward completion. For example, for one of the current projects, DIRM verification was particularly emphasized. As a result, this project was on schedule and progressing toward completion. This project also had a large contingent of DIRM employees to perform the verification function. Conversely, we noted that for a project where DIRM had not devoted as much effort to verification steps, there were delays in progress towards completion. This project was also not as fully staffed with DIRM employees insofar that it had only one DIRM employee, the Project Manager, assigned. Also, for this project, the role of verification was shared with the client organization, resulting in a lessening of control by the DIRM project team. This, in turn partially contributed to the "requirements creep" experienced. That is, the requirements definition phase was prolonged, and major delays in progress toward project completion occurred as a result. The delays caused the requirements definition and the design phases to extend for a greater time period than was originally intended for the entire project.

## **VERIFICATION THAT WORK PRODUCTS ADHERE TO SYSTEM DEVELOPMENT LIFE CYCLE STANDARDS NEEDS IMPROVEMENT**

An important element of verification involves ensuring adherence to SDLC documentation standards. Our review found that the quality of project documentation supporting development projects could be improved. We noted that certain required components of documentation were either absent, incomplete, or not developed in the proper chronological sequence. For the Functional Requirements Document, greater detail was needed in describing the proposed business process to be automated, and traceability matrices were not always developed. For the External Design Document, greater detail was needed in descriptions of the proposed technical architecture and more guidance could clarify when and how the External Design Document and the Internal Design Document could be combined. A number of other significant, but less frequent departures from the SDLC standards were also noted.

The FDIC's SDLC Manual establishes documentation standards, the purpose of which are to provide guidance to ensure the delivery of quality systems that meet user needs in a timely and cost-effective manner. As stated in its introduction, "The FDIC SDLC Manual is a tool that lends consistency to the process, products, and terminology which should be used to develop or maintain FDIC systems. It ensures sound communication and mutual understanding of SDLC processes between DIRM and the user."

Effective QA in the form of verification of compliance with established procedures can enhance a project's success. Such oversight is critical due to the pressures to deliver products to clients and, therefore, occasional tendencies to shortcut the SDLC process. Non-compliance with established procedures can also occur when requirements are misinterpreted. Enhanced specificity and increased use of illustrative examples could serve to reduce such misunderstandings.

## Requirements Definition Phase

We identified six development projects that we believe would have benefited from improved documentation during the Requirements Definition Phase. Two development projects would have benefited from an improved Functional Requirements Documents (FRD). The assurance of success for two other development projects would have been increased if the project team had developed a traceability matrix, a tool that connects the FRD to a related test plan. Finally, the project teams for two earlier projects initiated design and development work before FRDs were completed and approved, the consequences of which have been presented in the related audit reports. For the current projects, we cannot presently comment on the effects of cited documentation shortcomings because additional time would be required for such effects to present themselves. Discussion of needed documentation improvements follows.

- ***Improved Functional Requirements Document:*** For one of the projects reviewed, an improved FRD would have benefited the project by more clearly describing the proposed methods for addressing the client's business process requirements. The lack of clarity contributed to the resulting FRD not addressing all existing business processes or how they would be improved by the new system. For another project, the FRD did not describe a major business process to be supported by the planned system. As a result, the development team was forced to re-analyze the process after the departure of a contract employee who had acquired, but not documented, the business process to be supported.
- ***Traceability Matrix:*** In addition to a Functional Requirements Document, the SDLC Manual requires the development of a system test plan during the Requirements Definition Phase, including a traceability matrix linking requirements to the individual test scripts prepared later in the project. Test plans for two of the projects reviewed did not include a traceability matrix, reducing assurance that all functional requirements were addressed and adequately tested.
- ***Complete, Approved Functional Requirements Document:*** For two previously audited development projects, the project team proceeded with design and development work prior to the completion and approval of an FRD. For one of these projects, the project team revised certain requirements after design and development had commenced. Project personnel determined that the changes in requirements would require re-performing as much as 90 percent of design and development work that had been completed.

In our audit of another previous development project, we were informed that the delays in completing and approving the FRD were intentional inasmuch that the project team was employing the concept of evolutionary prototyping. DIRM agreed with our audit recommendation to evaluate and clarify when evolutionary prototyping can be used to reduce development schedules. We did not identify any current projects where development preceded the completion of the FRD. However, DIRM has not yet issued its clarifying guidance.

## **External Design Phase**

We identified five projects that would have benefited from improved documentation during the External Design Phase. For one project, the External Design Document lacked several important components required by the SDLC Manual. In three other projects, including one of the projects receiving a prior audit, the descriptions of the proposed technical architecture were not sufficiently detailed to properly facilitate reviews for feasibility and suitability. For another project, components for the External Design Document and the Internal Design Document were inappropriately combined, thereby prolonging the period required for the client to review and approve the system design. Discussion of possible improvements during the external design phase follows.

- ***Missing Required Components:*** The External Design Document for one project did not include all critical components required by the SDLC Manual, including the user interface screen designs and the output report layouts. These were later included in the Internal Design Document. However, the SDLC Manual requires end-user oriented components such as these to be included in the External Design Document which is prepared earlier in the project before other detailed design and development work commences. Also for this project, the traceability matrix in the External Design Document referenced only a few of the requirements earlier defined in the Functional Requirements Document. A complete traceability matrix is essential in providing support for the External Design Document review and approval process.
- ***Technical Architecture Descriptions:*** For three projects, including one of the projects previously audited, the proposed technical architecture was not fully described. The need for complete and accurate architecture documentation is critical in today's complex and rapidly changing technical environment. Today's systems are increasingly based on distributed technology that makes use of a variety of software technologies that must be successfully interfaced with one another. The feasibility and suitability of the technical architecture to be employed for a given project has to be carefully considered and reviewed by a variety of technical specialists. This is particularly critical because planned configurations often contain features or software that have not yet been applied to other projects. The costs of making changes to the technical architecture at a later stage of system development can be substantial because of the need to re-perform work.
- ***Combined External and Internal Design Documents:*** For six of the current projects



reviewed, the components required for an External Design Document were combined with those for the Internal Design Document and a single, Technical Design Document was produced. With the exception of one project, this practice did not appear to be detrimental to effective project management because the other projects were relatively limited in scope or did not require an overly lengthy period for design and development. However, for one of the larger scale projects reviewed, combining documents contributed to a 20-month period for the client to review and formally approve all needed functionality. By first providing the client with a separate External Design Document, a document which contains most of the information the client needs to review and approve, this time period may have been reduced. For one of the projects using the combined document approach, two virtually identical documents were issued, one designated as an External Design Document and the other as an Internal Design Document. Further, neither document was signed off by client representatives until completion of the development phase. These signoffs should have been obtained prior to commencing work on the development phase. The Project Manager could not provide a clear reason for the redundancy or the timing of document approval.

Postponement of signoffs by the client increases the risk that system programming will proceed incorrectly leading to later re-work and additional costs.

- ***Guidelines for Combining Documents:*** As stated previously, we did not always find it to be detrimental to effective project management to combine the External Design and Internal Design phases for those projects which were relatively limited in scope or did not require an overly lengthy period for design and development. Additionally, it is our opinion that this methodology can be successful when a proposed system can be broken down into clearly defined, independent functional modules. In such cases, internal design work can go forward on some modules while external design work is still in progress in other modules. In some cases, this practice can even be extended into the development phase. Because these distinctions are not addressed in the SDLC Manual, what is needed are guidelines for use by project management in deciding if and how a project may proceed with overlapping SDLC phases.

## **Internal Design Phase**

We noted needed Internal Design documentation improvements for only one project. However, the needed improvement was significant, i.e., an important component was missing from the Internal Design Document. Specifically, the Internal Design Document should have contained detailed descriptions of the internal logic to be employed, either graphically or in pseudo code using previously defined data elements. Such information is intended to provide the final bridge between requirements analysis and actual computer programming in describing the logic necessary to correctly write source code for all design units in the system. The absence of internal logic descriptions increases the likelihood that program bugs will reside in the completed system.

## **RECOMMENDATIONS**

We recommend that Director, DIRM, and Chief Information Officer:

- (1) Issue guidance to Project Managers describing their responsibility to ensure quality work from contractors. Such guidance should stress the importance of the DIRM project team verifying the completeness, accuracy, and consistency of deliverables or portions thereof prior to forwarding them for validation by the client. Included should be a requirement to ensure that contractor-provided development personnel do not communicate directly with clients without the knowledge of the Project Manager.
- (2) Clarify the SDLC Manual or issue supplemental instructions regarding distinctions between the documents produced for the External Design Phase and the Internal Design Phase, when documents produced for these phases can be combined, and how the IT infrastructure and related issues should be described.
- (3) Clarify the SDLC Manual or issue supplemental instructions regarding the circumstances in which it would be permissible (a) for design and development work to proceed pending approval of the Functional Requirements Document and, once the Functional Requirements Document has been approved, (b) for the project team to commence work on the development phase without having completed the design phase.

## **OTHER ISSUES**

We did not identify any recent or current development efforts that required independent validation efforts. However audits of earlier development projects illustrated the need for independent validation efforts when certain conditions are present. Specifically, development efforts intended to support a large or varied user population and development efforts of a long duration that may result in a turnover of client representatives are examples of instances that may require independent validation efforts. Because of the benefits that may sometimes accrue from independent validation, we suggest that DIRM develop guidelines for its Project Managers describing when to consider independent validation of user requirements across the various development phases.

As discussed earlier in this report, DIRM had eliminated its centralized QA function based on a decision to increase the responsibility and accountability of project managers and line managers for delivering quality systems. However, during the course of this audit, DIRM management has decided to further support the role of project and line management in producing quality products by implementing a new configuration and quality management function. This is to be embodied in a new Configuration and Quality Management group. This action came to our attention in conducting the Audit of Configuration Management (report no. 00-038) and we will be performing additional audit work pertaining to QA in the context of this new organization.

## **CORPORATION COMMENTS AND OIG EVALUATION**

On September 14, 2000, the Director, DIRM, provided a written response to the draft report that concurred with the recommendations. These comments are included as appendix I. The Corporation's response to the draft report provides the elements necessary for management decisions on the report's recommendations. Appendix II presents management's proposed action on our recommendations and shows that there is a management decision for each recommendation in this report.



September 14, 2000

**TO:** David H. Loewenstein  
Assistant Inspector General

**FROM:** Donald C. Demitros, Director

**SUBJECT:** DIRM Management Response to the Draft OIG Report Entitled, "Audit of DIRM's Actions to Ensure Quality Products"

The Division of Information Resources Management (DIRM) has reviewed the subject draft audit report and generally agrees with the findings and recommendations.

The OIG's recommendation along with DIRM's response is provided below:

**OIG Recommendation:**

We recommend that Director, DIRM, and Chief Information Officer:

- (1) Issue guidance to Project Managers describing their responsibility to ensure quality work from contractors. Such guidance should stress the importance of the DIRM project team verifying the completeness, accuracy, and consistency of deliverables or portions thereof prior to forwarding them for validation by the client. Included should be a requirement to ensure that contractor-provided development personnel do not communicate directly with clients without the knowledge of the Project Manager.
- (2) Clarify the SDLC Manual or issue supplemental instructions regarding distinctions between the documents produced for the External Design Phase and the Internal Design Phase, when documents produced for these phases can be combined, how the IT infrastructure and related issues should be described.
- (3) Clarify the SDLC Manual or issue supplemental instructions regarding the circumstances in which it would be permissible (a) for design and development work to proceed pending approval of the Functional Requirements Document and, once when the Functional Requirements Document has been approved, (b) for the project team to commence work on the development phase without having completed the design phase.

**DIRM Response:**

DIRM concurs with the recommendations and will prepare and issue supplemental guidance in accordance with the recommendations. The guidance will address the following:

- (1) Description of the responsibilities of Project Managers to ensure quality work from contractors, stressing the importance of the DIRM project team verifying the completeness, accuracy, and consistency of deliverables prior to forwarding them for validation, and including a requirement that contractor-provided development personnel do not communicate directly with clients without the knowledge of the Project Manager.
- (2) Clarifying the distinctions between the documents produced for the External design Phase and the Internal Design Phase, when documents produced for these phases can be combined, and how the IT infrastructure and related issues should be described.
- (3) Clarifying circumstances in which it would be permissible (a) for design and development work to proceed pending approval of the Functional Requirements Document and (b) once the Functional Requirement Document has been approved, for the project team to commence work on the development phase without having completed the design phase.

DIRM will issue the proposed guidance by January 31, 2001.

If you have any questions, please contact Rack Campbell, DIRM's Audit Liaison, at (703) 516-1422.

cc: Vijay Deshpande, OICM  
Wayne Gooding, DIRM  
Martha Adams, DIRM  
Janet Roberson, DIRM

**MANAGEMENT RESPONSES TO RECOMMENDATIONS**

The Inspector General Act of 1978, as amended, requires the OIG to report the status of management decisions on its recommendations in its semiannual reports to the Congress. To consider FDIC's responses as management decisions in accordance with the act and related guidance, several conditions are necessary. First, the response must describe for each recommendation

- the specific corrective actions already taken, if applicable;
- corrective actions to be taken together with the expected completion dates for their implementation; and
- documentation that will confirm completion of corrective actions.

If any recommendation identifies specific monetary benefits, FDIC management must state the amount agreed or disagreed with and the reasons for any disagreement. In the case of questioned costs, the amount FDIC plans to disallow must be included in management's response.

If management does not agree that a recommendation should be implemented, it must describe why the recommendation is not considered valid. Second, the OIG must determine that management's descriptions of (1) the course of action already taken or proposed and (2) the documentation confirming completion of corrective actions are responsive to its recommendations.

This table presents the management responses that have been made on recommendations in our report and the status of management decisions. The information for management decisions is based on management's written response to our report.

<b>Number</b>	<b>Corrective Action: Taken o Planned/Status</b>	<b>Expected Completion Date</b>	<b>Documentation That Will Confirm Final Action</b>	<b>Monetary Benefits</b>	<b>Management Decision: Yes or No</b>
1	DIRM will prepare and issue supplemental guidance to ensure quality work from contractors stressing the importance of the DIRM project team verifying the deliverables prior to forwarding them to the client and including a requirement that contractor- provided personnel do not communicate directly with clients without knowledge of the Project Manager.	01/31/01	Directive or Memo	Not Quantifiable	Yes
2	DIRM will prepare and issue supplemental guidance to clarify the distinctions between the documents produced for the External Design Phase and the Internal Design Phase, when documents produced for these phases can be combined, and how the IT infrastructure and related issues should be described.	01/31/01	Directive or Memo	Not Quantifiable	Yes
3	DIRM will prepare and issue supplemental guidance to clarify circumstances in which it would be permissible for concurrent work among several phases.	01/31/01	Directive or Memo	Not Quantifiable	Yes